Microdialysis

An sensitive method for estimating plant-available N released during litter decomposition

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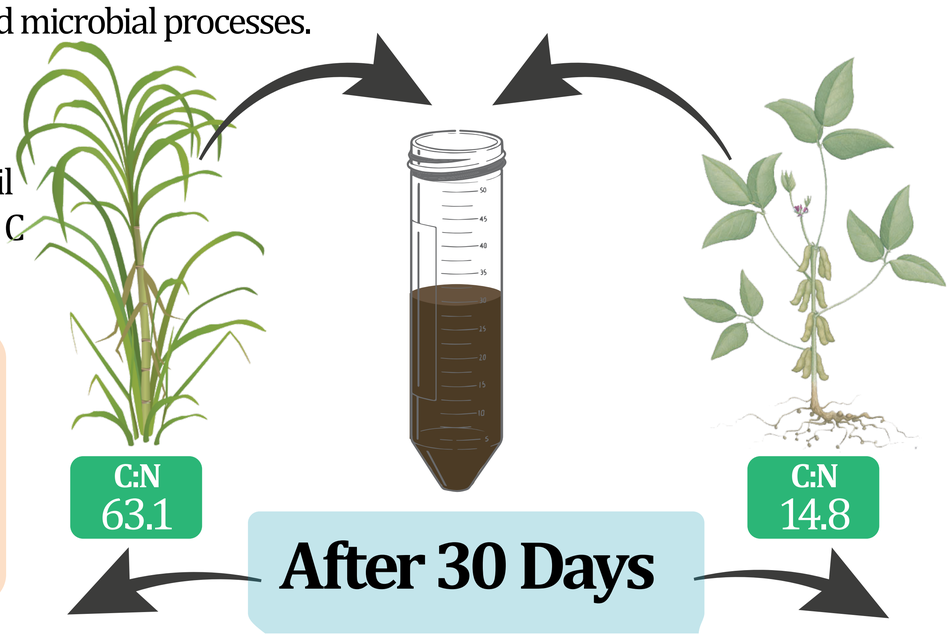
Introduction

Given the importance of nitrogen (N) availability in controlling N acquisition in plants and microbes, estimating soluble and exchangeable N forms in soil is vital to understanding these processes. However, we have relied on extraction methods that **severely disrupt the soil environment,** biasing estimates of soil N. Microdialysis offers an alternative method of sampling soil N with minimal disturbance, and here we compare it with traditional KCl and H_2O extractions, in the context of litter decomposition, and expected microbial processes.

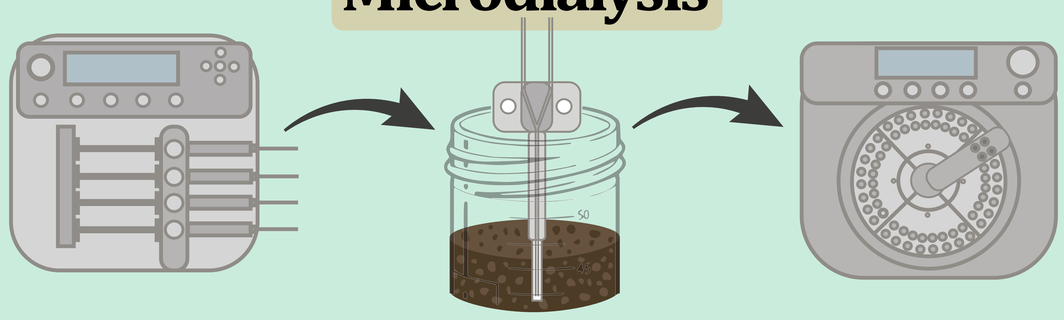
Methods

Sugarcane and **soybean** litter was added to soil microcosms at 10%, 70% and 200% of organic C content of soil.

	mg N per g Soil	
Treatment	**Sugarcane**	**Soybean**
Control	0	0
Lo (+10% C)	0.01	0.05
Mid (+70% C)	0.08	0.35
Hi (+200% C)	0.23	1.0



Microdialysis

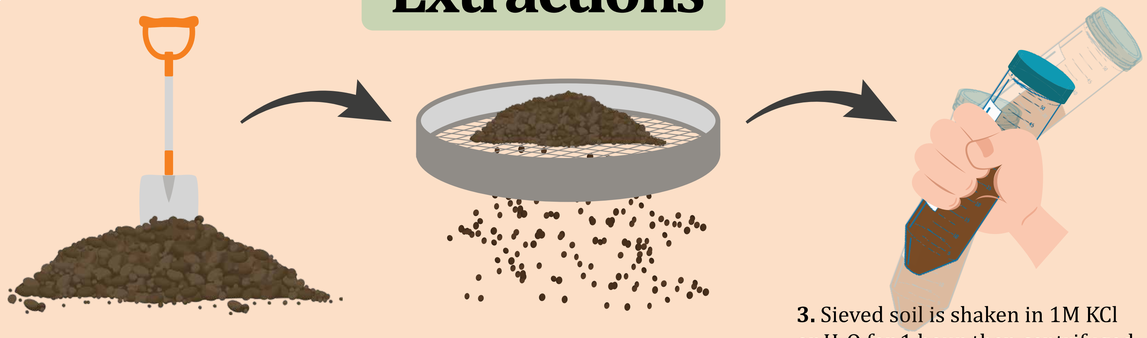


1. Pump pushes perfusate (dH_2O) through to the probe.

2. Probe is positioned *in situ*. Soil solutes passively diffuse across probe membrane.

3. Refridgerated fraction collector collects the dialysate, ready for N analysis.

Extractions



1. Soil is destructively harvested.

2. Soil is passed through a 2mm sieve.

3. Sieved soil is shaken in 1M KCl or H_2O for 1 hour, then centrifuged, with supernatant collected for N analysis.

Analyses

NO_3^- → Colourmetric Griess Method

NH_4^+ / Total AAs → Ultra Pressure Liquid Chromotography

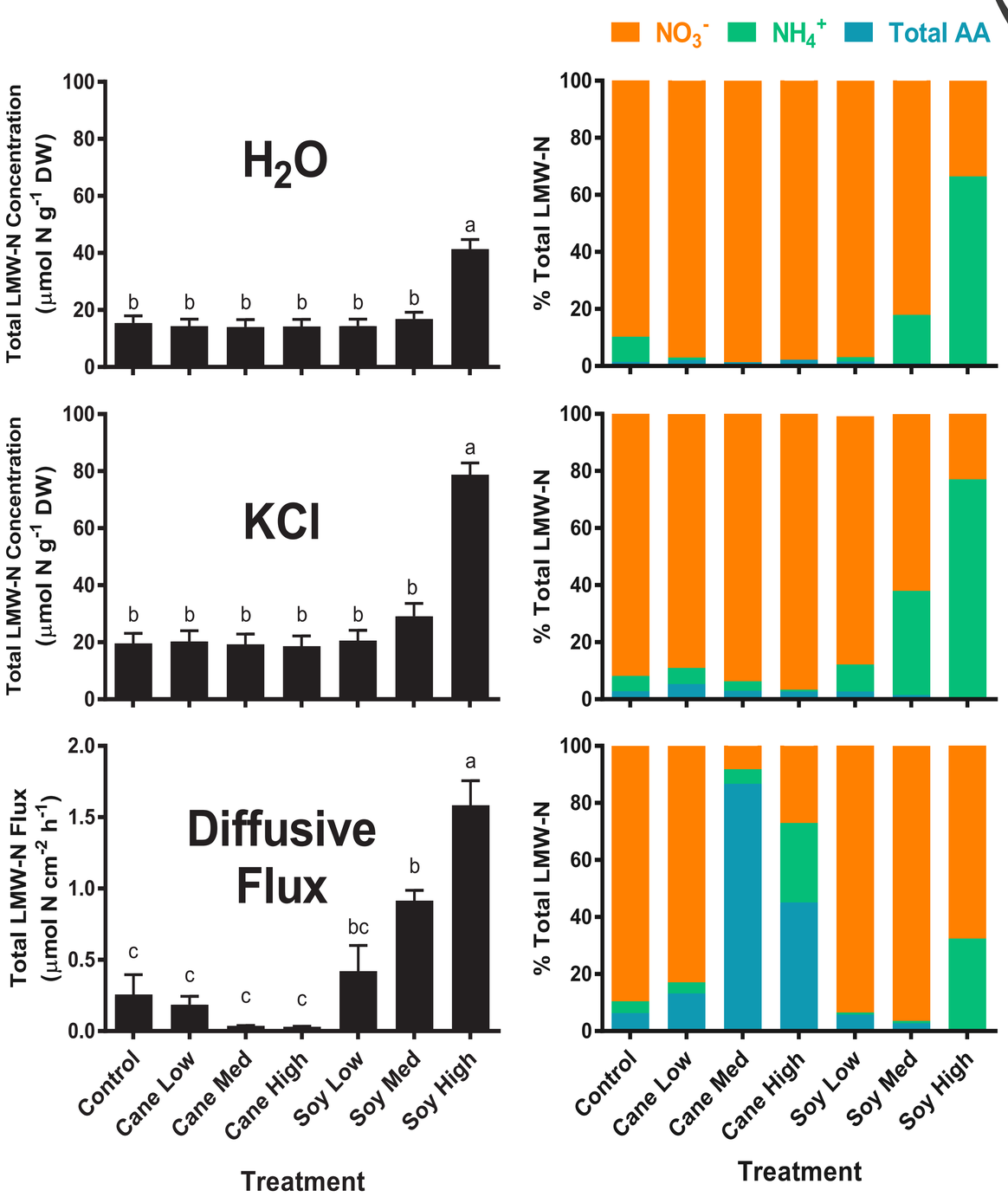


Figure 1. Proportion (%) of Total Low Molecular Weight Nitrogen (LMW-N) and total LMW-N concentration of water (H_2O) and Potassium Chloride (KCl) soil extractions (top and middle rows); % of Total LMW-N Flux and Total LMW-N Flux of diffusive flux (microdialysis) measurements (bottom row), of soils incubated for 30 days with sugarcane and soybean litter.

Results

Diffusive fluxes (measured via microdialysis) provided a high-resolution snapshot of N availability at day 30, highlighting N cycling processes that were insufficiently resolved using salt or water extractions. Patterns of N **immobilisation** were observed in sugarcane treatments; significant N **mineralisation** was found in soybean treatments. Each pattern increased with litter concentration, and was consistent with observed microbial activity and current concepts of N cycling.

Such patterns were **not apparent** in KCl or water extractions, both showing uniform N concentrations and N species across treatments, with the exception of Hi Soybean treatments.

Conclusions

These findings challenge the effectiveness of conventional soil extraction techniques to sufficiently estimate plant-available N, and to resolve N cycling processes in soil environments. Conversely, microdialysis represents a sensitive method for estimating soil nitrogen, with potential for providing genuine insight into spatial and temporal factors affecting N cycling *in situ* within undisturbed soil.

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